

STUDIES IN NEARCTIC DESERT SAND DUNE ORTHOPTERA, PART V

A New Genus and Two New Species of Giant Sand Treader Camel Crickets with Keys and Notes

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This is a continuation of the author's studies on Desert Sand Dune Biotae conducted under grant from the National Science Foundation during the summers of 1957-1960 inclusive.

The discovery, in July of 1960, of a new genus and three new species, one of gigantic size for a sand treader, came as a distinct surprise. The Utah species herein described was discovered in 1958, but additional material obtained in Western Utah, in 1960, indicated its affinity to the new genus and not to *Ammobaenetes* Hubbell as originally believed.

PROVISIONAL KEY TO THE SAND TREADER CAMEL CRICKETS AND THEIR ALLIES

1. Mesotibiae with 3 to 5 pairs of dorsal spines (sometimes irregular) exclusive of the calcars 3
 Mesotibiae with 2 pairs of dorsal spines (sometimes only 3 spines) exclusive of the calcars 2
2. Sand basket present and formed by the crowding together apically of long aciculate spurs. Ovipositor short, approximating the length of the pronotum *Rhachocnemis* Caudell
 Sand basket absent. *Ceuthophilus*, *Pristoceuthophilus*, *Udeopsylla*, *Styracosceles*, *Phrixocnemis*.
3. Sand basket formed of 4 to 6 pairs of long, moveable, aciculate, dorsal spurs, somewhat flattened on their inner faces and crowded apically on the caudal tibiae, their length greater than the tibial depth 5
 Sand basket absent. Caudal tibial spurs with length about equal to tibial depth 4
4. Segments of caudal tarsi- 3, their distoventral angle well rounded. Ovipositor 1.5 to 2.0 times the pronotal length *Daihinia* Haldeman
 Segments of caudal tibiae- 4, their distoventral angle strongly acute or spinose. Ovipositor length about equal pronotal length *Daihiniodes* Hebard
5. Size medium to very large. Externo-inferior keel of caudal femora armed with several large median teeth or spines in addition

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to smaller teeth. Tarsal segment ratio -3-4-4 with distoventral angles acute. Ovipositor short and stout, its length about equal to pronotal length *Daihinibaenetes* n. genus

Size small. Externo-inferior keel of caudal femora either non-dentate or armed with very small teeth. Ovipositor approx. 1.5 to 2.0 times the pronotal length 6

6. Tarsal segment ratio -3-4-4 with distoventral angles well rounded. Externo-inferior keel dentate *Daihiniella* Hubbell

Tarsal segment ratio -3-4-3 with distoventral angles acutely produced or spinose. Externo-inferior keel unarmed *Ammobaenetes* Hubbell

Daihinibaenetes, n. genus

This new genus has much the appearance of *Daihinia* Haldeman and *Daihiniodes* Hebard, in size, and general features but is separable from these two genera by possession of the diacritical "sand basket" as typically observed in *Ammobaenetes* Hubbell. This sand basket is formed by the grouping or crowding together apically on the distal third of the caudal tibiae of 5 to 6 pairs of long, acuminate, dorsal spurs, their length considerably greater than the tarsal depth. The name proposed for the new genus indicates its apparent generic affinity with *Daihinia*, *Daihiniodes* and *Ammobaenetes*.

Closest relationship appears with *Daihiniodes* which has the same tarsal segment ratio of 3-4-4 for pro-, meso-, and metatarsi and both *Daihiniodes* and the new genus have the distoventral angle or apices of these segments acuminate acute, acute or spinose. The spination on the externo-inferior keels of the caudal femora is also closely similar in that they bear several large, centrally-placed spines followed by a row of small dark teeth in both genera; the interno-inferior keel is more heavily toothed in the new genus. *Daihiniodes*, however, lacks the sand basket and the external dorsal spurs of the caudal tibiae, with their length about equal to the tibial depth, are more widely spaced in the apical half with 1 to 2 smaller teeth interspersed except at the extreme apex. In the new genus 5 to 6 pairs of long, acuminate, dorsal spurs, somewhat flattened on their internal faces and with length greater than tibial depth occupy the apical third of the caudal tibiae to form the sand basket and this character is considered of major generic importance. *Daihinia* has a tarsomere ratio of 3-4-3 compared to 3-4-4 in the new genus and the distoventral angles are well rounded in *Daihinia* distinguishing it from the spinose angles of the tarsomeres in the new genus and *Daihiniodes*. As in *Daihiniodes* and *Daihinia* the dorsal spurs on the mesotibiae are the same, namely four pairs.

The short ovipositor of *Daihinibaenetes* n. g., about equal to the pronotal length, indicates closer relationship to *Daihiniodes* where the length is similar, than to *Daihinia* where the length is about twice the pronotal length and more slender.

Daihinibaenetes, as now understood, is restricted to sand dune areas in southern Colorado at high elevations, dune areas in north-eastern Arizona and western Utah, but up until the present it has not been found in the San Rafael Desert of southeastern Utah.

DESCRIPTION: Size very large with the typical form of a heavy bodied Rhaphidophorid. Head, thorax and abdomen typical, the chief diagnostic features existing in the spination of the legs.

Leg spination as follows: Forelegs with externo-inferior keel unspined, interno-inferior keel with 1 to 4 minute teeth and occasionally a larger, pale, apical spur; protibiae dorsally with a pair of apical calcars or spurs, the ventral surface bearing 3 pairs of large, aciculate spurs plus the apical ones; protarsus 3-segmented, the first two segments extremely short and with their distoventral angles spinose or acuminately acute, the third segment almost one-third the length of the protibia with its distoventral angle acute. Middle legs with mesofemora unspined dorsally; ventrally with 3-4 pairs of small spines in addition to the apical ones. Mesotibiae with 4 pairs of large, dorsal, acuminate spines, usually paired but sometimes irregularly spaced, plus the apical calcars; ventrally with 3 pairs of long, acuminate spurs, one pair centrally, two pairs apically, plus a larger pair of calcars. Mesotarsus 4-segmented, the first about half the length of the fourth, the second and third segments very short, the first three segments with their distoventral angle spinose, of which segment 2 is largest; fourth and apical segment with the distoventral angle acute only.

Hind legs with internal dorsal ridge of caudal femora bearing a row of small sharp teeth and with a few scattered teeth external of this row. Externo-inferior keel with 2 to 4 very large spines located about centrally, followed caudally by a row of closely spaced smaller spines or teeth; the interno-inferior keel with a row of numerous closely, or more-widely spaced teeth for its entire length. Caudal femora in the female with the same dorsal teeth, the spines and teeth of the externo-inferior keel much smaller than in the male; teeth of the interno-inferior keel less reduced. Caudal tibiae in the male with 5 to 7 pairs of long, aciculate, dorsal spurs in the apical half, sometimes the first 2 or 3 pairs nearest the middle with a single small tooth between the longer spurs; the basal half usual with two pairs of spurs, the first two pairs preceded by a series of 4 teeth each, with 2 teeth usually separating the second and third pairs of long spurs. Caudal tarsus 4-segmented, the first segment longer than the fourth, the second and third very short; the first to the third with their distoventral apices acuminately produced into long spinose spurs of which that of segment 2 is largest; segment 4 with its distoventral angle acute. Ventral surface of male caudal tibiae often asperate with small appressed teeth terminating with the tibial sub-apical tooth found in most Rhaphidophorids. Spination of caudal tibiae and tarsi in the female closely similar to that described for male. Ovipositor short and stout with abruptly truncate apex, its length about the pronotal length.

TYPE SPECIES: *Daihinibaenetes giganteus*, new species.

Key to the Species of *Daihinibaenetes*

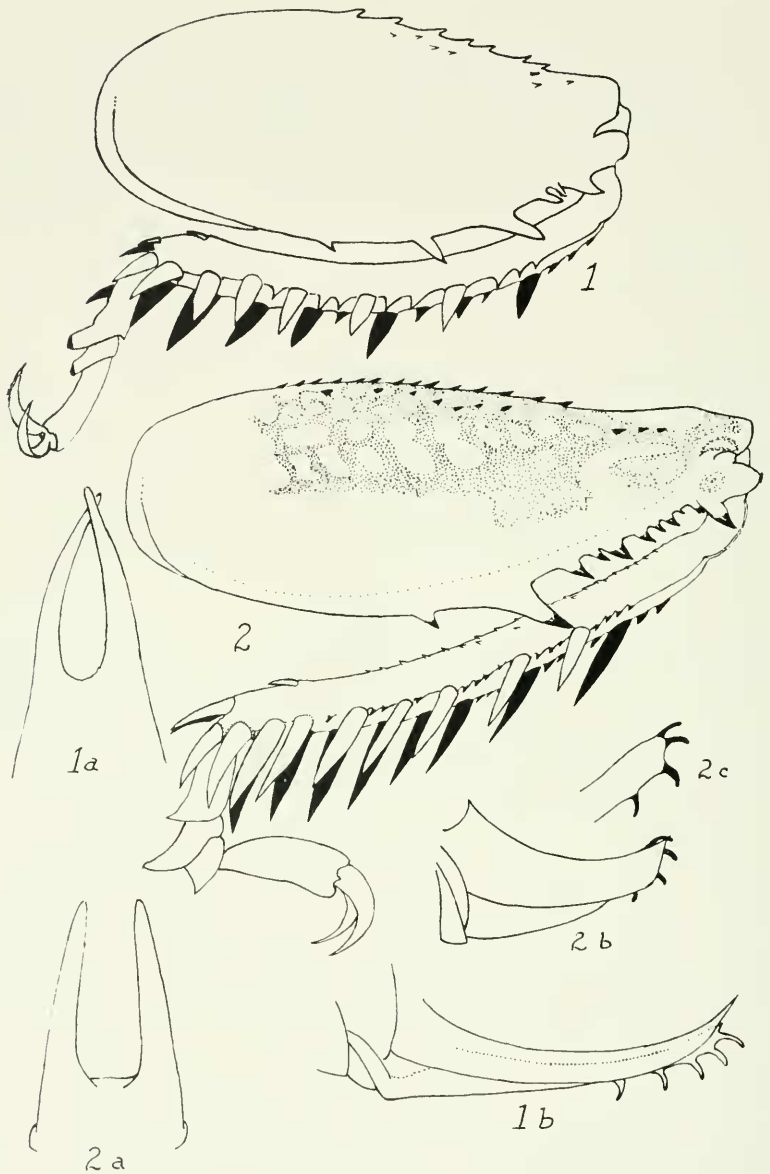
1. Size very large. Median spines of external inferior keel of caudal femora very large. Teeth of internal inferior keel of caudal femora in single row. Ventral ridge of caudal tibiae asperate with short, heavy, appressed teeth. Forcipate arms of male subgenital plate long. Ovipositor short with abruptly truncate apex *giganteus* n. sp.
Size medium. Median spines of caudal femora smaller. Teeth of internal inferior keel of caudal femora in several rows at base. Ventral ridge of caudal tibiae relatively smooth 2
2. Forcipate arms of male subgenital plate long. Dorsal teeth of caudal tibiae normal in size. Five spurs in the sand basket with or without teeth between the fifth and sixth spurs. Ovipositor short, abruptly truncate at apex *arizonensis* (Tink)
Forcipate arms shorter. Dorsal teeth of caudal tibiae heavy and triangulate. Six spurs in the sand basket closely spaced. Ovipositor short, abruptly but roundly truncate *tanneri* n. sp.

Daihinibaebetes giganteus, n. sp.

The new species closely resembles *Daihinia brevipes* Haldeman in size and general features but the coloration is much paler and the caudal femora less massive and more elongate; the huge spines of the external inferior keel more centrally located than in *Daihinia*. The new species also differs distinctly by possession of the sand basket of much longer acuminate spurs crowded together into the apical third of the caudal tibiae and the tarsomere ratio is 3-4-4 and not 3-4-3 as in *Daihinia brevipes* with their distoventral angles spinose and not rounded as in *D. brevipes*. From *Daihiniodes hastiferum* (Rehn) it differs chiefly in the conformation of the external ventral spines of the caudal femora and by possession of the sand basket; the tarsomere ratio and the spination of the distoventral angles of the tarsomeres being similar in the two genera. The same differences hold between *Daihinibaenetes giganteus* and *Daihiniodes larvale* Strohecker of the White Sands National Monument in New Mexico.

MALE.— Size very large with heavy body typical of certain Rhaphidophorids. Head, thorax and abdomen of typical form.

Leg spination as follows: forelegs with profemora without dorsal spination; antero-ventral keel armed for most of its length with a row of 4-5 black minute teeth with the apical one much larger and which may be indicative of maturity in the male. Protibiae unarmed dorsally except for a pair of calcars; ventral keels with 3 medium sized spurs in the apical two-thirds plus a large apical calcar and 3 much larger spines and one apical calcar on the posterior ventral keel. Protarsus 3-segmented, the first two segments very short, all with distoventral angles acuminately produced.



EXPLANATION OF PLATE 1

Daihinia brepes Haldeman. 1. Left hind leg of male specimen from Cherokee, Oklahoma, 1a. Subgenital plate of same. 1b. Subgenital plate of female from Boise City, Cimarron County, Oklahoma.

Daihinibaenetes giganteus. 2. Left hind leg of Type Male from Great Sand Dunes National Monument, Colorado. 2a. Subgenital plate of Type Male. 1b. Subgenital plate of Allotype Female, Great Sand Dune Natl. Mont. 2c. Enlarged view of apical teeth of ventral valvula of Allotype Female.

Middle legs with mesofemora unarmed dorsally, the anterior ventral keel with usually 3 black teeth plus a longer subapical spur; the posterior ventral keel with usually 2-3 teeth beyond the middle and with an apical longer spur. Mesotibiae dorsally with 4 pairs of spurs plus the apical pair of calcars; ventral with 3 pairs of spurs, the proximal pair almost central, the two other pairs subapical plus a larger pair of calcars. Mesotarsus 4-segmented, segments 2 and 3 very short, segment 1 about half the length of segment 4, the first three with the distoventral angle acuminate produced into long spurs. the fourth segment with the angle acute.

Hind legs with the caudal femora rather short and deep with the internodorsal keel lined in its central portions by an irregularly or double-appearing row of black, semi-appressed teeth with some scattered teeth exteriorad of this row. Inferior external keel with one huge tooth about the apical two-thirds, preceded by a smaller but large tooth and followed caudadly with about ten black teeth of irregular size with a large tooth at the genicular angle. Internoinferior keel lined its entire length with a single row scattered black teeth, in its basal half these teeth are interspersed with minute teeth; internal genicular lobe also toothed. Caudal tibiae on its dorsal surface armed with 8 large pairs of aciculate spurs, convex on their outer surface, somewhat angulately flattened within, the apical 6 pairs beyond the middle forming the sand basket in which area the tibiae is visibly broadened. the three basal pairs of spurs preceded by 1 to 4 small black teeth and pairs 4 to 6 preceded by one smooth black tooth, followed by two subapical spurs and the apical and smaller calcars. Ventral surface of caudal tibiae with several irregular rows or small, heavy, dark appressed teeth occupying the median area from near the base to the subapical, semi-appressed conical larger spur just ahead of which are a pair of small slender calcars. Caudal tarsus 4-segmented, segments 2 and 3 very short; segment 1 much larger and only slightly longer than the fourth segment. Distoventral angles of first three segments acuminate produced, that of the fourth segment only acute.

Abdomen with penultimate tergite sinuate with a slight median convexity. Supra-anal plate somewhat triangulate. Cerci very long. acuminate and hirsute. Subgenital plate with straight forcipate arms.

LIVING COLORATION: Pale with more tan along the dorsum of the entire body with dark brownish gray markings as follows: an open "X" or hour glass-shaped marking on the dorsum of the pronotum; mesa and meta-nota and first two segments of the abdomen with their posterior margins heavily bordered with brownish gray. the remaining abdominal segments with posterior margins more finely margined. Legs pale flesh-colored with the dorsal areas in the apical two-thirds of the caudal femora with a netting effect of dark brownish gray. The eyes are black and the head concolorous with the body.

MALE HOLOTYPE: Great Sand Dune National Monument, 33 miles NE Alamosa, Colorado. July 11, 1960, on cold wet sand after

heavy rain. elevation 8200 ft., E. R. Tinkham. Caliper measurements in mms.: body length 21.9; total length to apex of hind femora 26.8; pronotum 6.6 hind femora 16.9; hind tibiae 15.5 mms. Holotype Male deposited in the Tinkham Eremological Collection.

FEMALE: closely similar in size and characteristics to the Type and differing only in the degree of dentition and spination of the hind legs as follows: caudal femora with teeth of dorsal ridge greatly reduced in size; external inferior keel with teeth much reduced and fewer in number as are also those of the inferior internal keel. Rows of heavy short, appressed teeth on the ventral ridge of caudal tibiae almost evanescent in the female; small dorsal teeth preceding the first three pairs of long spurs in basal half of caudal tibiae reduced in number although spurs and teeth in apical half closely similar to the male. Subgenital plate a shallow sector with basal margin straight and posterior margin circular. Ovipositor approximately the length of the pronotum, heavy, the dorsal valvulae abruptly and rather squarely truncate with apices acute, the ventral valvulae armed apically with 4 pairs of unciniate hooks with blunt apices, the basal pair the smallest (see figs. 2b and 2c. Plate).

FEMALE ALLOTYPE: Same data as the Holotype Male. Glogau caliper measurements for alcoholic preserved female which is close to living size: body length 28.0; caudal femora 13.8; caudal tibiae 11.2; ovipositor 4.6 mm. Type in the Tinkham Eremological Collection.

MALE PARATYPE: 27, same data as type. Range in millimeters for dried specimens first preserved in 10 to 80 per cent alcohol: body length 16.8-22.7; hind femora 11.5-16.0; caudal tibiae 10.0-12.7; pronotum 4.2-5.4 mm. Paratypes identical to the Male Type except for size range.

FEMALE PARATYPE: 27, same data as the Allotype. Range in mms, preservation as in Male Paratypes: body length 16.8-22.5; caudal femora 11.5-13.4; caudal tibiae 9.8-10.5; pronotum 4.5-5.2; ovipositor 4.9-5.0. Paratypes to be deposited in the major Orthopterological Museums.

ECOLOGY: a cold storm front, moving north from northern New Mexico and which had deluged rain and snow on my car. also greeted my arrival at the Great Sand Dunes National Monument, 33 miles north and east of Alamosa, Colorado, in San Luis Valley, with similar flood. It seemed bitterly cold in the late evening at the camp grounds lying on the edge of the great sahara of sand at an elevation of 8300 feet. The dunes themselves lie at the northwestern base of that lofty range known as the Sangre del Cristo.

I expected to find nothing out on those cold barren sands the night of July 10, 1960. The only vegetation in sparse scattered patches was the scurf pea *Psoralea lanceolata* and dune grass *Oryzopsis hymenoides*; but most of the sand areas were completely bare. The camp ground in heavy vegetation marked the fringe of the dunes and due to the heavy precipitation a shallow stream 15 to 20

feet across flowed across the edge of the dunes—a rather strange phenomenon.

At 9:30 p.m. it was dark enough to start out with 2 Coleman lanterns and collecting equipment. The air temperature had warmed to 13.5° C (56.3° F), the sand was 14.5° C. Within 200 yards of camp I shortly found the first Giant Sand Treader lying stretched out on the wet sand drinking and soaking up the moisture which was most welcome to its body after a considerable drowth. For several hours all sand treaders were found immobile and in similar position, the temperature and the moisture making them still. Just before midnight I found several males crawling about high up on the slopes of the main sand mountain but by then the temperatures had risen to 15.0° C for air and 13.5° C for the sand surface. The series was taken over approximately a square mile area. Some females were left to carry on the race.

BIOLOGY: Most of the adults seemed freshly teneral; some late stadia nymphs were taken and these later matured by feeding lettuce. On the low sand flats nearer camp and at the south base of the great sand ridge practically all specimens were females and largely confined to bare sand ridges or low sand crests. Most of the males were found later that night on the lower flanks of the great sand ridge, but higher up still no specimens were found due to the barrenness of the environment.

FOOD: My field notes state “one female on a ridge crest had gnawed into a few wet blades of dead dune gress. Another had eaten a cutworm moth and left the dark wings on the sand. Still another specimen was found devouring the head end of a living pupa of a large scarab that appeared to be a *Phyllophaga* sp. which the rain had apparently brought to the sand surface.” All other specimens of the big series lay prostrate on the wet sand drinking up the moisture.

ENEMIES: Only one specimen was found recently killed, its anterior end chewed off. I looked up and ten feet away spied a Great Basin Spadefoot (*Scaphiopus intermontanus*) sitting under a small scurf pea plant. As this was the only other signs of life observed that night, I am certain the toad had tried to eat the sand treader but found her spiny legs unpalatable.

ORTHOPTERAN ASSOCIATES: No other nocturnal associates were found. Next morning out in the hot humid sand flats I found in the scurf pea areas 1 female *Camnula pellucida* and 1 *Craytypedes neglectus* after diligent searching. At 11 a.m. the air temperature was 23° C, the sand 30.0° C. Also taken were several tiny speckled acridid nymphs resembling *Coniana snowi*. These were placed in half-pint ice cream cartons and by feeding produced in August typical *Trimerotropis agrestis*.

Daihinibaenetes arizonensis (Tinkham), n. comb.

Ammobaenetes arizonensis Tinkham, 1947, Amer. Midland Nat. 38(1):130-133.
pl. 1, figs. 1, 3, pl. 2, figs. 1, 2.

In 1936, Dr. Theodore H. Hubbell in his monumental work on "A Monographic Revision of the Genus *Ceuthophilus*" created the genus *Ammobaenetes* by key description and designated *Daihinia phrixonemoides* Caudell as the genotype.

At the time of the description of *Ammobaenetes arizonensis* in 1947, no additional species of this genus had been described, although unknowingly to the author, that same year Dr. Strohecker named *A. lariversi* from the Sand Springs dunes in western Nevada. In 1947, it was perfectly natural to consider any sand treader an *Ammobaenetes* and any male and female from the same dunes as undoubtedly of the same species. Fortunately or unfortunately, the assumed pair of *A. arizonensis*, collected on small sand dunes near the headquarters of the Petrified Forest in July of 1940, were not both described as in keeping the pair some days alive for photography and observation, the female destroyed part of the male's genitalia making it unfit for description. The male, however, was a true *Ammobaenetes*, the female referable to the new genus *Daihinibae* herein described, and this accident leaves the *Ammobaenetes* of this sand area undescribed. Unknown too, in 1940, but now not uncommon, is to find three different genera and species of Rhabdiphirids on the same sand dunes. In July, 1960, at these dunes at the Petrified Forest, I took the new *Daihinibaenetes*, the new *Ammobaenetes* and a *Ceuthophilus* sp. all in the same evening on a small patch of sand.

The species, *Daihinibaentes arizonensis* (Tinkham) differs from *D. giganteus* by its smaller size, the smaller large teeth on the externo-inferior keel of the caudal femora, the much heavier small dentition on the dorsal keels of the caudal tibiae, the form of the male pseudosclerite, the lack of the dark "X" on the pronotum as well as other minor features.

MALE TYPE: a large heavy bodied Rhabdiphorid with short and unusually deep caudal femora with the teeth on the basal half of the caudal tibiae unusually large and heavy; foremargin of the pronotum with a slight angular emargination. The chief characters lie in the spination or dentition of the legs. The attachment of the hind legs is well back of the middle portions of the body.

Leg spination as follows: forelegs with a forward projecting spine on the forecoxae; forefemora with dorsum unspined, externo-inferior keels with 1 to 2 small, dark, medium teeth. interno-inferior keels with 4 to 5 dark, well-spaced teeth in the middle areas. Foretibiae unspined dorsally with a pair of apical calcars of which the external ones are much the largest; inferior keels with 3 pairs of acuminate spurs, those on the outer keels the largest, plus a pair of apical calcars. Foretarsi 3-segmented, short, the first two segments extremely short with their distoventral apices acuminately produced or spines, the third segment with this angle acute.

Middle legs with the mesocoxae unarmed; mesofemora unarmed dorsally, the externo-inferior keel with 5 to 6 small teeth and 2 to 3 additional, interspersed, minute teeth plus one small apical calcar;

the interno-inferior keel with 3 to 5 large teeth plus a larger acuminate calcar; mesotibiae with 4 pairs (sometimes on 3 and $\frac{1}{2}$ pairs) of long acuminate spurs plus a similar pair of calcars, ventrally with the externo-inferior keels with 3 pairs of small teeth, one median and the other 2 apical plus a larger pair of calcars; mesotarsi 4-segmented, segments 2 and 3 very short, segments 1 and 4 short but much longer, the distoventral angles of segments 1 to 3 spined, that of segment 4 acute.

Hind legs, short and heavy, the caudal femora with depth slightly greater than one-third the length; the interno-dorsal ridge lined with a row of short, heavy, semi-appressed teeth from one-quarter the distance from the base to almost the geniculi with scattered similar teeth exteriorad of these; externo inferior keel with 3 to 4 large widely spaced teeth in the middle areas of the caudal femora, these teeth preceded by 2 to 3 much smaller teeth and followed caudally by a row of minute and larger teeth (the size of those on the interno-dorsal ridge) plus a larger tooth on the lower genicular lobe; interno-inferior keel lined its entire length with semi-appressed teeth, the size of those on the interno-dorsal ridge, those teeth nearest the base smaller and forming a double row, plus 1 to 2 teeth on the lower genicular lobe. Caudal tibiae about $\frac{5}{6}$ ths the length of the caudal femora, of heavy build with apical third somewhat reflexed; ventral surface with one minute, central, sub-apical tooth plus a pair of larger slender calcars. Externo-dorsal keels with 8 very large aciculate spurs, two in the basal two-thirds and 6 in the apical third which form the outer edge of the sand basket, plus an apical calcar; the first basal spur preceded by 3 to 5 short heavy teeth and the spurs of the sand basket preceded by 4-6 heavy teeth. Interno-dorsal keel with 8 large aciculate spurs plus the apical calcar, the first at the extreme base, the second about the basal third, with 6 very large aciculate spurs forming the inner edge of the sand basket. First basal spur preceded by one short heavy tooth, the second by 5 to 6 teeth increasing gradually in size distally, the third preceded by 3 to 4 regularly increasing larger teeth and one tooth separating spurs 3 and 4 of the sand basket. Caudal tarsi 4-segmented, segments 2 and 3 very short, segments 1 and 4 much longer and equal and about three times those of the second and third; the distoventral angles of the first three segments spined, that of segment 2 the longest and segment 4 with the distoventral angle acute.

GENITALIA: with penultimate tergite arcuately sinuate, supranal plate a broad arcuate lobe, cerci very long, acuminate, hirsute; subgenital plate with two long straight, tapering forcipate arms; pseudosclerite black, semi"X"-shaped.

COLORATION: uniformly pale with rich golden tan on the dorsal areas of the entire body, the posterior dorsal margin of each thoracic and abdominal segment lightly infuscated with brown. The dorsal apical two-thirds of the caudal femora infuscated with a network of broad lines.

TYPE MALE: Low semistabilized sand areas along the west bank of a wash tributary to Cottonwood Wash, one quarter mile ESE of the Petrified Forest Headquarters and just north of the bridge on Highway 260, July 8, 1960, Ernest R. Tinkham, night collecting (this is the same type locality as for the Female Type). Caliper measurements in millimeters: body length 21.7; pronotum 4.5 in dorsal median length, caudal femur 13.5 x 5.5 in depth; caudal tibiae 11.1 mms. Type in the Tinkham Eremological Collection.

PARATYPE MALES: 3, same data as the Type Male. Range in millimeters: body length 19.0-24.6; pronotum 4.6-4.6; caudal femora 14.1-14.5; caudal tibiae 10.5-10.8 mms. Paratypes in Tinkham and University of Michigan Clns.

Paratypes closely similar to the Type Male, the chief difference being in the dentition of the externo-inferior keel of the caudal femora. Here the long teeth may range from 2 to 4 in number, preceded by 2 to 4 small teeth and followed caudally by 10 to 14 small and larger teeth plus a large and small tooth on the lower genicular lobe.

TYPE FEMALE: The description of the Type Female was quite adequately portrayed in my 1947 publication.

PARATYPES: 3 females, same type locality but collected July 8, 1960 with the Type and Paratype Males. Range in millimeters: body length 21.5-24.0; pronotum 4.2-4.4; caudal femora 11.6 x 4.3—11.7 x 4.3; caudal tibiae 9.1-9.3; ovipositor 4.2—4.2 mms. Paratype distribution the same as noted above.

Paratypes closely similar to the Type Female. Foretibiae (missing in the Type Female) without dorsal spines except for two apical calcars, the outermost of which is much the larger. Inferior keels with 3 pairs of long acuminate spines in the apical half plus one pair of calcars, those on the exterior keel much the largest. Foretarsi 3-segmented, segments 1 and 2 very short, segment 3 much longer, the distoventral angle of segments 1 and 2 spined, of segment 3 acute.

FIELD NOTES: The genus *Daihinbaenetes* makes a peculiar and characteristic trail in the sand, quite distinct from that of *Ammobaenetes*. Once recognized it is not easily forgotten. The trail of *Ammobaenetes* is that made of numerous tarsal claw-points in the sand, whereas that of *Daihinbaenetes* not only leaves the claw-points but draws or pushes its body along across the sands. In so doing the trail appears as if made up of alternately placed pieces of pie or sectors of one-eighth size, these sectors formed when the short and powerful hind legs push the body forward first one side then the other. Specimens in the field were found by recognizing the trail and following it until the specimen was found, or the trail lost in the dune grass and vegetation or tracked to the burrow which was excavated into the rather hard packed sand for 18 inches or more and at about a 45 degree angle.

At 9:30 p.m. July 8, 1960 the air temperature was 22.0° C., the sand temperature 21.0° C. At this time I discovered one of the

female *D. arizonensis* (Tinkham) ovipositing in the sand a few inches from the mouth of her burrow in the sand. At 9:45 p.m. I found the first male by excavating it out of its burrow which was about 18 inches long with the resting chamber 9 to 10 inches below the level of the sand. At the resting chamber sand temperature was a warm 28.0° C. At 11 p.m. the air was 20.0, the sand 18.5° C and it was at this time that the first *Ammobaenetes* were found as well as the single mature *Ceuthophilus* sp. of small size.

ORTHOPTERAN ASSOCIATES: The nocturnal orthopteran fauna consisted of *Daihinibaenetes arizonensis* (Tinkham) which was rare, the rarer *Ammobaenetes* n. sp. which appeared about midnight on these rather small and limited dunes, and a *Ceuthophilus* sp. which was rarer yet. In the *Atriplex confertifolia*, *Plagiostira albonotata* males were softly stridulating with their rapidly produced "zee-zee-zeeezees" that continued on for minutes at a time. The phasmid *Parabacillus coloradus* was also very rare. Diurnal orthopteran associates were *Xanthippus montanus*, *Eremiacris virgata* on the dune grass and *Trimerotropis bilobata* on the sand. More extensive day collecting would yield one or two others.

DUNE FLORA: these low, semistabilized dunes, 30 to 40 feet wide and about 600 feet long, were covered with a considerable variety of vegetation chief of which was *Atriplex confertifolia*, Silver sagebrush *Artemisia filifolia*, Dune Grass *Oryzopsis hymenoides*, Dune Broom *Parryella filifolia*, Scurf pea *Psoralea lanceolata*, Spectacle Pod *Diathyrea wislizeni*, Buckwheat *Eriogonum subreniforme* and *E. divaricata*, Sand Verbena *Abronia fragrens* and *A. elliptica*. Ragweed *Ambrosia psilostachys*, Sacaton *Sporobolus Wrightii*, and less common plants such as *Yucca angustissima*, flax *Linum aristatum*, Snake weed *Gutierrezia microcephala*, Bastard Toad Flax *Comandra pallida*, *Solanum* sp., *Sphaeralcea incana*, *Muhlenbergia pungens* *Orobranche multiflora*, *Stephanomeria exigua* and still others. Along the wash proper and below the level of the low dunes grew the giant Sand Reed *Calemovilfa gigantea*. I am indebted to Mr. E. Neil Stephenson, Park Naturalist, for the identification of the plants.

Daihinibaenetes tanneri, n. sp.

Differs from *D. gigantea* by the much smaller size and from *D. arizonensis* by the slightly smaller proportions. The male of *D. tanneri* is distinguished from the larger males of the two other species by the short forcipate arms of the subgenital plate which are very long in the two species previously described above; dentition on the interno-dorsal ridge of the caudal femora much more reduced than in the other two species of *Daihinibaenetes* and the reduced dentition at the base of the interno-ventral keel of the caudal femora, these and the reduced dentition on the inferior keels of the fore and middle legs will furnish ample means of separation. The female of *D. tanneri* is distinguished from the other two larger species of the new genus by smaller size and by the much reduced dentition on the inferior keels of all femora; from *D. gigan-*

teus by the deeper and more triangular subgenital plate and from *D. arizonensis* by the reduction of the dentition on the inferior keels of the caudal femora. The rounded nature of the truncate apex of the ovipositor is also distinctive.

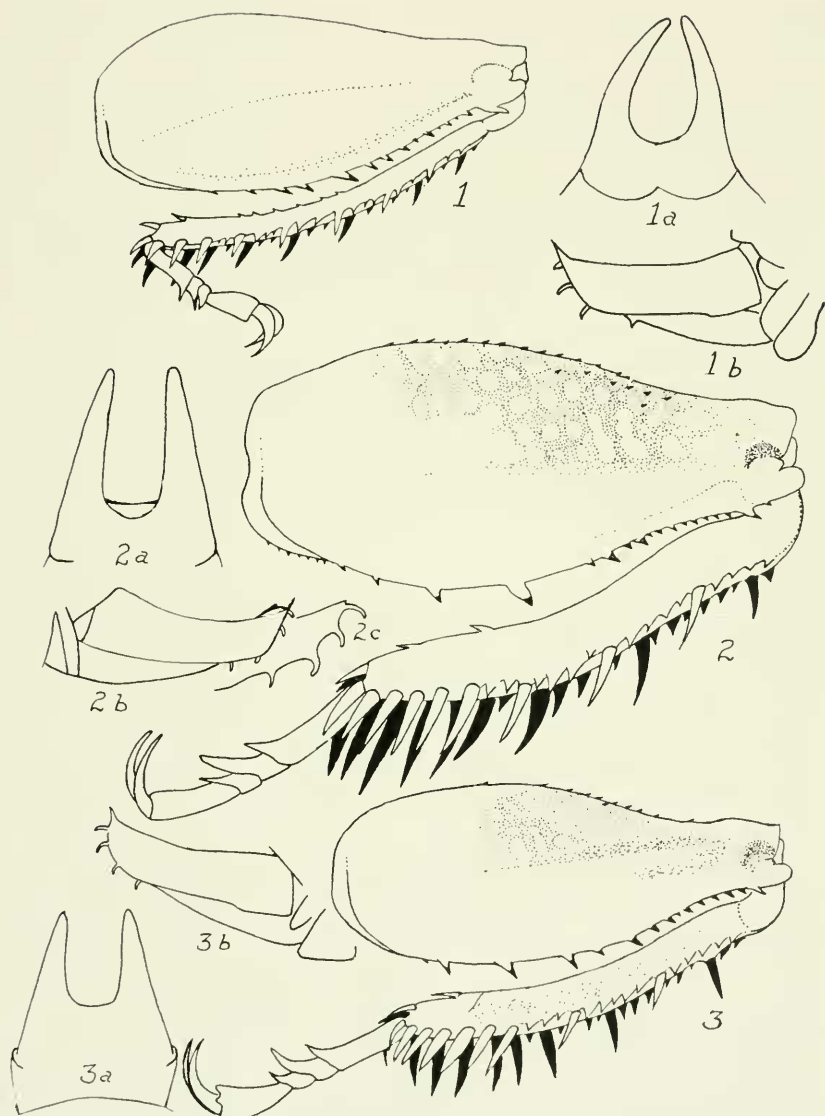
MALE: size medium and of rather heavy build with powerful and heavy hind legs. Form typical of the genus with the foremargin of the pronotum bearing a slight arcuate emargination. The chief distinguishing features exist in the dentition of the legs.

Leg Spination as follows: Forelegs with the forecoxae bearing a small toothlike projection on the anterior vertical keel; forefemora unspined above, the interno-inferior keel bearing in its apical half 4 small black teeth of irregular size with sometimes a similar tooth in the basal half. Foretibiae unspined above but with a pair of large apical calcars; that externad being the largest; ventrally with 3 pairs of long tapering spurs, plus an apical pair of calcars, those spurs on the externo-inferior keel the largest. Foretarsi 3-segmented, the first 2 segments very short, the third segment short but about three times the length of the first segment; the distoventral angles of the first two segments spined and that of the third segment acute.

Middle legs with mesofemora unspined dorsally; ventrally with 4 to 5 small teeth on the interno-inferior keel (leg in same position as the forelegs) and the externo-inferior keels bearing 4 to 5 small irregular teeth plus larger apical calcars. Mesotibiae dorsally with 4 pairs of large sharp spurs plus a pair of similar calcars; ventrally with 3 pairs of smaller spined spurs plus similar apical calcars. Mesotarsi 4-segmented, segments 2-3 very short, 1 and 4 short but three times as long as 2 or 3, distoventral angles of segments 1 to 3 spined, of segment 4 acute.

Hind legs with caudal femora heavy and short, their depth slightly greater than one-third their length; interno-dorsal ridge with 10 black, sparsely spaced, teeth in the apical two-thirds with 2 to 3 teeth externad of this row. External inferior keels of caudal femora with 4 to 5 large teeth in the middle sections, preceded by 1 to 3 small black teeth and followed caudally by a row of 8 to 10 larger, black teeth (smaller than the 4 to 5 large teeth) plus a large tooth on the lower genicular lobe; interno-inferior keel with an entire row from base to apex of small, black, irregularly-sized and spaced, teeth plus one large and sometimes several small teeth on the genicular lobe.

Caudal tibiae ventrally with 1-2 small subapical teeth plus a pair of larger calcars; dorsal surface with externo-dorsal keel bearing 8 long acuminate spurs plus one smaller apical calcar. 6 (spurs 3-8) in the apical third and forming the outer row of the sand basket, one at the basal quarter, the second in the center; spur 1 preceded by 4 to 5 heavy, dark, short teeth, spur 2 by 4 to 5 similar teeth and spur 3 (first of sand basket) by 3 similar teeth. Interno-dorsal keel bearing 8 long acuminate spurs plus smaller apical calcar, the first spur basal, the second not quite at the middle, the remaining spurs 3 to 8 forming the inner row of the sand basket; spur 1



EXPLANATION OF PLATE 2

Daihiniodes larvale Strohecker, from White Sands: 1. Left hind leg of Paratype Male. 1a. Subgenital plate of Male (alcoholic specimen). 1b. Subgenital plate of Female (alcoholic specimen).

Daihinibaenetes arizonensis (Tinkham): 2. Left hind leg of Male Type. 2a. Subgenital plate of Type Male. 2b. Subgenital plate of Female Paratopotype. 2c. Same showing enlargement of apical teeth of ventral valvula.

Daihinibaenetes tanneri: 3. Left hind leg of Male Type. 3a. Subgenital plate of Male Type. 3b. Subgenital plate of Female Allotype.

preceded by 2-3 teeth (similar to those on outer keel), spur 2 by 5 to 6 teeth, spur 3 by 4 irregular teeth and spur 4 by a single tooth.

Caudal tarsi 4-segmented, segments 2 and 3 very short, segments 1 and 4 about three to four times as long as 2 and 3 and equal in length; segments 1 to 3 with the distoventral angles spined, that of segment 2 the largest, and the distoventral angle of segment 4 acute. Genitalia: with penultimate tergite very gently arcuate; supraanal plate triangulate with the apex deflexed at a right angle; cerci very long, acuminate, sparsely hirsute with long hairs; pseudosclerite a strongly arcuate lobe; subgenital plate with rather short, parallel forcipate arms, much shorter than in the other two larger species of *Daihinibaenetes*.

MALE HOLOTYPE: Oak City Dunes, about 3 miles WSW of Oak City, Millard County, Utah, on Utah Highway #125, night collecting, June 15, 1958, Ernest R. Tinkham. Caliper measurements in millimeters: body length 21.0; pronotum 4.2, caudal femora 13.2, caudal tibiae 10.3; antennae 35 mms. Type in the Tinkham Entomological Collection.

FEMALE: Identical in size to the Holotype Male; pronotum as in the male.

Leg spination as follows: Forelegs with the forecoxae bearing a small toothlike tubercle on the anterior vertical keel; fore femora unspined above; external and internal keels with 1 to 2 minute teeth subapically; foretibiae unspined dorsally but with a pair of apical calcars of which the external one is twice the size of the internal one; ventral keels with 3 pairs long tapering spurs plus a pair of apical calcars, the external spurs twice the size of the internal ones. Foretarsi 3-segmented, segments 1 and 2 very short, segment 3 twice the combined length of segments 1 and 2; the distoventral angles of segments 1 and 2 spined, of segment 3 acute.

Middle legs with mesofemora unspined dorsally, ventrally, the keels with 1 to 2 minute teeth; mesotibiae with 4 pairs of long tapering dorsal spurs plus 1 pair of apical calcars; the ventral keels with 3 pairs of medium-sized acuminate spurs plus a pair of large calcars. Mesotarsi 4-segmented, segments 2 and 3 very short, segments 1 and 4 similar in size and about twice the combined length of segments 2 and 3; distoventral angles of segments 1 to 3 spined, of segment 4 acute.

Hind legs with 5 to 6 very minute teeth on the internal dorsal ridge; externo-inferior keels with 10 small scattered teeth, mostly apical, including one on the genicular angle or lobe; interno-inferior keels with 10 to 15 minute teeth most of which are crowded subapically with 2 on the inner lower genicular lobe. Caudal tibiae, ventrally, with one median, small, subapical tooth and a pair of larger calcars; external dorsal keels with 8 long aciculate spurs plus the apical calcar, the first spur about the basal quarter, the second about central on the keel and 6 spurs crowded in the apical half and forming the outer edge of the sand basket, spur 1 preceded by 3 to 4

small teeth (much more slender than in the male), spur 2 preceded by 3 to 4 similar teeth, spur 3 preceded by 3 similar teeth; internal dorsal keels with 8 long aciculate spurs plus the apical calcars, the first basal, the second spur about the apical third and spurs 3 to 8 in the apical half and forming the inner tines of the sand basket; spur 1 preceded by 2 to 3 small teeth, spur 2 preceded by 4 to 5 larger teeth; spur 3 by 3 to 4 similar teeth; spur 4 by 0 to 1 teeth. the remaining spurs of the sand basket without intervening teeth. Tarsomeres as in the Male Type. Ovipositor short and stout, its length about equal the pronotal length; apex of dorsal valvula somewhat roundly and abruptly truncate; apex of ventral valvula with four uncinata hooks, their apices blunt.

FEMALE ALLOTYPE: same data as the Male Type. Measurements as follows: body length 21.8; pronotum 4.2; caudal femur 11.0; caudal tibia 9.5; ovipositor 4.6 mms. for alcoholic specimen). Allotype in the Tinkham collection.

MALE PARATYPES: 10 ♂ same data as the Type Male. 4 ♂ Lynndyl Dunes, 10 miles north of Lynndyl, Millard County, Utah. June 21, 1958. 10 ♂, Hawbush Dunes, 10 miles north Flowell and 8 miles west Holden, Millard County, June 14, 1958. 4 ♂, Hawbush Dunes, same location, July 25, 1960. Range in measurements: Oak City dune series: body length 19.2-23.6; pronotum 3.9-4.2; caudal femur 11.8-12.8; caudal tibiae 9.9-10.0 mms. Lynndyl series: body length 16.0-18.9, pronotum 3.8-3.6, caudal femur 11.0-11.3, caudal tibia 9.2-9.0 mms. Hawbush series: body length 18.5-18.8; pronotum 3.8-4.2; caudal femur 10.8-12.7; caudal tibiae 9.0-9.2 mms. Paratypes closely similar to the Male Type with slight variations in the leg spination as follows: caudal tibiae, external dorsal keel with usually 4-5, sometimes 2, 3 or 6 teeth preceding the basal or spur 1; usually 4-5, sometimes 3, 2 or 6 teeth preceding spur 2; usually 2 or 3, sometimes 4 or 1 preceding spur 3; usually 0-1 teeth preceding spur 4; remainder of spurs of sand basket without intervening teeth. Internal dorsal keel with usually 2-3 sometimes 4 teeth preceding spur 1; usually 4-5 sometimes 6 teeth preceding spur 2, usually 2-4 teeth preceding spur 3, usually 1 sometimes no teeth preceding spur 4, rest of sand basket entire.

FEMALE PARATYPES: 6 ♀ same data as Allotype. 4 ♀ Lynndyl dunes June 21, 1958; 7 ♀ Hawbush dunes June 14, 1958; 3 ♀ Hawbush dunes July 25, 1960. Range in millimeters: Oak City series body length 21.2-23.4; pronotum 3.8-4.2; caudal femur 11.7-11.6 caudal tibia 8.8-9.4; ovipositor 4.7-4.5 mms. Hawbush series: body length 15.3-20.3; pronotum 3.8-3.8; caudal femur 9.9-9.9; caudal tibia 7.4-7.8; ovipositor 4.2-4.0 mms. Lynndyl series: body length 17.3-22.3; pronotum 3.8-4.0; caudal femur 9.5-10.8; caudal tibia 7.8-9.0; ovipositor 4.4-4.1 mms. Leg spination range as follows: caudal tibiae, external dorsal keel with usually 4 sometimes 5, rarely 3 or 1 teeth preceding spur 1; usually 4-5, sometimes 3 or 6 teeth preceding spur 2; usually 2-4, sometimes 1 or 6 teeth preceding spur 3; usually 1 or no teeth preceding spur 4; rest of sand basket

entire. Internal dorsal keel with usually 2 sometimes 1, 3 or 4 teeth preceding spur 1; usually 4-5, sometimes 6 teeth preceding spur 2; usually 3-4 sometimes 2 teeth preceding spur 3, one or no teeth preceding spur 4, rest of sand basket entire.

Paratypes will be deposited in the major orthopterological museums of the country.

This interesting sand treader is named with pleasure after Dr. Vasco M. Tanner, Chief of the Department of Entomology, Brigham Young University and Editor of the Great Basin Naturalist; a scientist who has greatly advanced our knowledge of the fauna of the Great Basin Desert.

ECOLOGY: The Oak City Dunes where crossed by Highway #125 are in places quite blackish hued due to the generous admixture of fragmentized pumice or lava from the lava bed areas west of Flowell. In more stabilized areas immediately west of these blackish drift dunes, the sand is finer and lighter in color with scurf pea (*Psoralea* sp.) in places and such areas are the habitat of the recently described *Trimerotropis agrestis barnumi* and other acridids. The blackish dune areas are usually very dry and barren, margined by a heavy fringe of dead Russian thistle with *Artemisia tridentata* and *Sarcobatus vermiculatus* in surrounding sand flats. The thistle fringe provides protection for the Utah Giant Sand Treader herein described. These dunes running northeast—southwest also meet the gravel road some 6-7 miles northeast running from Oak City to Lynndyl. Attempts to collect in this latter area where the dunes encroached on Junipers were impossible due to the attacking swarms of mosquitoes.

The Lynndyl dunes occupy a tremendous area of approximately 100 square miles of very fine whitish sand forming a billowy sea of dunes up to 25 feet high formed on the north lea of a ridge of mountains (axis East-west) about five miles north of Lynndyl, with a long arm of dunes extending north towards Jericho, Utah. The collecting area was found by crossing the UP railroad tracks on a small road, 10 miles northeast of Lynndyl, from Highway 50 and 6, thence continuing northwest to the end of the road by some big Junipers on the edge of the dunes. From here, a hike of several miles northwest brought the collector to the northern fringe of dunes which were encroaching and destroying a sparse Juniper forest. The dunes here, 25 feet high encircled dead and living trees. The sand here was so fine it formed "rubber sand" and would not break through when tread upon. Here too, Russian thistle formed dense fringes to the dunes and this fringe provided protection for the sand treaders. At 7:30 p.m. June 20, 1958, an hour before sundown, the air temperature was 85° F.; at 8:30 p.m. when night collecting began with lantern sand was 71 and air 74° F. and by midnight the air was 62-63 and the sand 60° F.

The Hawbush Dunes, north of Flowell and west of Holden, lie in an area of dense and varied vegetation with ponds fringed by cattails and juncus meadows on the north and old stabilized sand

ridges bearing aged *Artemesia tridentata*, rabbit brush (*Chrysothamnus* spp.) and other types of bushes in very dense formation on the west. The flora of this area is very rich and the area should be created into a State Park.

The Giant Utah Sand Treaders in their polished reddish brown coats were found at the damp base of long, bare, parallel sand ridges, often 30 feet high, which rested on a rather bare and wet sand substrata or sand flats. At 10:45 p.m. June 14, 1958, the sand and air was 60° Fahrenheit. The tracks made were typical of the new genus being a broad trail of roundly triangular abdominal sternite marks fringed laterally by the pinpoints of the tarsal joints that pushed the heavy bodied creature along over the sands. Once recognized the tracks will reveal the presence of this new genus. In other places scurf pea formed loose coverage over low sand areas, but to adequately describe this area would take pages of report.

Orthopteran Associates. At the Oak City Dunes there were no other nocturnal associates; the diurnal associates were *Trimerotropis strenua*, rare on the barren drift dunes, and *T. a. barnumi* and *T. p. pallidipennis* as well as *Melanoplus pachardi* on the scurf pea areas.

At the Lynndyl dunes a very small mature *Ceuthophilus* sp. was the only nocturnal associate. At the Hawbush dunes the only nocturnal associate was a *Plagiostira* sp. on the dense *Artemesia* ridges. The diurnal orthopterans were *T. a. barnumi*, *T. bilobata*, *Conozoa wallula*, *Hesperotettix* sp., *Melanoplus* sp., and *M. pachardi*, the latter three on Rabbit brush and Northern sagebrush.

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